Accessing exchange and ventilation times scales from 3-D modelling

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We applied a multi-purpose three-dimensional ocean general circulation model to compute water renewal/ventilation time scales and exchange paths for a large coastal embayment situated off the central eastern coast of Australia (Hervey Bay) that shows features of an inverse estuary.
Water renewal or ventilation time scales are not directly observable but can easily be diagnosed from numerical simulations. Improved knowledge of these time scales can assists in evaluating the water quality of coastal environments and can be utilised in sustainable marine resource management.
The numerical studies are performed with the COupled Hydrodynamical Ecological model for REgioNal Shelf seas (COHERENS). The model, adopted for Hervey Bay, provided insight into ventilation pathways, and renewal time scales were found to exhibit a strong spatial variability. More than 80 % of the coastal embayment was fully ventilated after about 70-100 days, with the eastern and western shallow coastal regions ventilated more rapidly than the central, deeper part of the bay.
The concept of a single ’typical’ ventilation timescale characterising this particular coastal embayment is inadequate and the consideration of spatial variability is clearly important. Hence in a second set of simulations local monitoring boxes and neutral buoyant Lagrangian tracers have been used to focus on this spatial variability. Simple parameters are derived to estimate local sedimentation, transport processes or places of high/low biological production.